TABLE 1: Recommended Cover Crops

Species	Seeding Rate (lbs/ac) or (bu/ac) [1/]	Seeding Depth (inches) [2/]	Purpose [3/]									Planting Dates [4/]			Kill/Suppression Dates [5/]
			E	O	N	F	B	W	S	P	C	Zone 1	Zone 2	Zone 3	All Zones
Summer Annual Grasses															
Annual Ryegrass *Lolium perenne* spp. *multiflorum*	10(10-20)	0.25 - 0.5										Sow right after small grain or early vegetable harvest.			No later than 2 weeks before planting the next crop.
Sorghum x Sudangrass Hybrids *Sorghum bicolor*	35 (35-40)	1.0 - 1.5										After Jun 7	After Jun 1	After May 20	
Spring Oats *Avena sativa*	60 (60-125)	1.0 - 1.5										Apr 25	Apr 15	Apr 1	
Summer Annual Forbs & Legumes [6/]															
Buckwheat [7/] *Fagopyrum esculentum*	40 (40-120)	0.5 - 1.5										After danger of frost.			No later than 1 weekbefore planting the next crop.

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Species	Seeding Rate (lbs/ac) or (bu/ac) [1/]	Seeding Depth (inches) [2/]	Purpose [3/]									Planting Dates [4/]			Kill/Suppression Dates [5/]
			E	O	N	F	B	W	S	P	C	Zone 1	Zone 2	Zone 3	All Zones
Winter Annual Grasses															
Annual Ryegrass *Lolium perenne* spp. *multiflorum*	10 (10-20)	0.25 - 0.5	■	■	■			■	■	■		Aug 15	Sept 1	Sept 15	No later than 2 weeks before planting the next crop.
Spring Oats *Avena sativa*	3 bu/ac	1.0 - 1.5	■					■	■			Sept 15	Sept 25	Oct 1	Spring oats are likely to winter-kill most years throughout Pennsylvania.
Winter Barley *Hordeum vulgare*	2bu/ac	1.5 - 2.0	■	■	■			■		■	■	NA	Sept 25	Oct 5	No later than 2 weeks before planting the next crop.
Winter Rye *Secale cereale*	2 bu/ac	1.5 - 2.0	■	■	■			■	■	■	■	Oct 1	Oct 5	Oct 15	
Winter Wheat *Triticum aestivum*	2 bu/ac	1.5 - 2.0	■	■	■			■		■		Oct 10	Oct 15	Oct 25	
Winter Annual Legumes [6/]															
Field Peas *Pisum spp.*	70 (70-220)	1.5 - 2.0				■	■			■		NA	NA	Aug 30	No later than 1 week before planting the next crop.
Hairy Vetch *Vicia villosa*	15 (15-20)	0.5 - 1.5	■		■	■	■			■		Aug 15	Aug 30	Sept 15	
Crimson Clover *Trifolium incarnatum*	15 (10-20)	0.25 - 0.5	■			■	■	■				NA	Sept 1	Sept 15	

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Species	Seeding Rate (lbs/ac) or (bu/ac) [1/]	Seeding Depth (inches) [2/]	Purpose [3/]									Planting Dates [4/]			Kill/Suppression Dates [5/]
			E	O	N	F	B	W	S	P	C	Zone 1	Zone 2	Zone 3	All Zones
Winter Annual Legume/Grass Mixtures [6/]															
Hairy Vetch **Plus:** Rye, Wheat, or Barley	15 (15-20) 75	 1.0 - 1.5										Aug 15	Aug 30	Sept 15	No later than 2 weeks before planting the next crop.
Hairy Vetch **Plus:** Oats	15 (15-20) 60	 1.0 - 1.5										Sept 15	Sept 25	Oct 1	
Austrian Winter Pea **Plus:** Rye, Wheat, or Barley	50 (50-60) 40	1.0 - 1.5 1.0 - 1.5										NA	NA	Aug 30	
Crimson Clover **Plus:** Rye, Wheat, or Barley	12 (12-20) 60	0.25 - 0.5 1.5 - 2.0										NA	NA	Aug 30	
Winter Annual Brassicas [8/]															
Kale *Brassica oleracea*	5 (5-12)	0.25 - 0.5										Aug 15	Sept 1	Sept 15	No later than 1 week before planting the next crop. These cover crops may entirely winter-kill, depending on geographic location and/or the severity of the winter.
Winter Rape (or Canola) *Brassica napus*	5 (5-12)	0.25 - 0.5										Aug 15	Sept 1	Sept 15	

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Species	Seeding Rate (lbs/ac) or (bu/ac) [1/]	Seeding Depth (inches) [2/]	Purpose [3/]									Planting Dates [4/]			Kill/Suppression Dates [5/]
			E	O	N	F	B	W	S	P	C	Zone 1	Zone 2	Zone 3	All Zones
Short-lived Perennials															
Red Clover [6/] *Trifolium repens*	8 (8-12)	0.25-0.5										Seed together with oats in March or April. Broadcast into corn or soybeans beginning mid-June.			No later than 2 weeks before planting the next crop.
Birdsfoot Trefoil [6/] *Lotus cirniculatus*	5 (5-10)	0.25 max.										Can be established early spring or late summer.			
Long-lived Perennials [9/]															
Orchardgrass *Dactylis glomerata*	10	0.25										Seed spring or fall			Terminate and reestablish as needed to meet primary purpose.
White Clover *Trifolium repens*	5	0.25										Seed early spring or early fall			

NOTES FOR TABLE 1:

1. Seeding Rate: The primary seeding rate should be used when a drill is used to establish a cover crop. A seeding range is also often given, in parentheses, if broadcast seeding and cultipacking with average seedbed conditions use the middle of the range. If aerial seeding, increase the primary seeding rate by 50%.Timing of planting and site conditions should also be considered when determining a seeding rate.

2. Seeding Depth: Provides the recommended depth to plant seed to obtain the best germination. Plant deeper in sandy soil, and less deep on clayey soil.

3. Purposes: Lists the benefits obtained from each species or mix:
E - Erosion control and surface water protection; when adequate cover is present during critical erosion periods. RUSLE 2 shall be used to determine if planned cover crop establishment will be soil loss goals.
O - Organic matter added; Although harvesting for grain or forage is allowed under this purpose, organic matter increases will be the greatest if crop vegetative growth and/or crop residues are left on the field and if the next crop is established using no-till.
N-Nutrient Capture; Nutrient capture can be optimized by establishing cover crops as soon as possible after crop harvest.

F - Nitrogen fixation; Legumes and legume grass mixes will fix nitrogen if the specific Rhizobbium bacteria are present in the soil or if seed is inoculated at the time of planting.

B- Biodiversity; Planting early and terminating late will increase the biodiversity in the system.

W - Weed suppression; crop residues will be left on the soil surface to maximize weed suppression.

S - Supplemental Forage; cover crops may be either hayed or grazed as long as adequate cover for resource protection remains. Choose forage suitable for the livestock species.

P -Reduce particulate emissions; particulate emissions are reduced when at least 80% ground cover is maintained during the planting of the next crop. This purpose would require burn down (not harvest) and no-till establishment of the next crop.

C-Soil Compaction; Establishing cover crops early will maximize root growth to minimize soil compaction.

4. Planting Dates: Generally the latest planting dates based on Pennsylvania Crop Zones Map (see Figure 1) are listed. Successful establishment of the planting will vary with environmental conditions, but is more likely to occur if the crop is planted two or more weeks prior to the latest planting date listed in the table. Planting more than two weeks before the listed date is permissible when weather conditions are favorable. The latest date indicated should rarely be exceeded. At higher elevations in each crop zone earlier planting dates should be considered.

5. Kill/Suppression Dates: The preferred timing for killing the cover crop or suppressing growth of the crop. Harvesting or herbicide treatment may be used, or the crop may be plowed under, depending on the purpose and desired use of the cover crop. Crops may be planted into living cover crops with additional management recommendations being considered.

6. Legumes: Legume seed should be inoculated if specific Rhizobium bacteria for the selected legume are not known to be present in the soil. Generally seed should be inoculated.

7. Buckwheat: Germinates in 3 to 5 days. Matures in 70 to 90 days. Stems breakdown quickly; quick but short lived erosion control benefits; good emergency cover crop. Good nectar source for pollinators and beneficial insects if allowed to flower for at least 20 days. Also can function as a weed suppressant.

8. "Brassica" cover crops (family *Brassicaceae*) include rape, kale, mustard, turnips, etc. Canola is a term for rape cultivars that are used to produce oil and other products for human and livestock consumption. Oil from other rape varieties is less palatable and is used for industrial purposes. All rape varieties are suitable for use as cover crops.
Brassicas can be especially useful for planting after early vegetable crops. Brassica cover crops are well-suited for uptake of residual nitrogen in the fall because they grow rapidly during periods of cool weather. They may also provide other benefits such as suppression of detrimental nematodes, plant diseases, and weeds.

There are a few potential drawbacks to using Brassica cover crops:
(1) Brassicas have low tolerance for poorly drained or frequently flooded soils;
(2) Plants are susceptible to below freezing temperatures, and may winter-kill, especially in Zones 1 and 2. It is important that they be well-established (6 to 8 leaf stage) before a hard freeze in order to provide the benefits of a cover crop;

(3) If allowed to set seed, these plants may become "weedy" in crop fields.

9. Perennial cover: Long lived perennials will most commonly be used as a living mulch between the rows or orchards, vineyards, or vegetable beds (other types of permanent cover should be established using the conservation cover or the critical area planting standard). Species selection should be compatible with adjacent crop, should not compete with the crop, or harbor insects that are a pest to the primary crop. Management considerations include the timing of mowing and weed control.

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